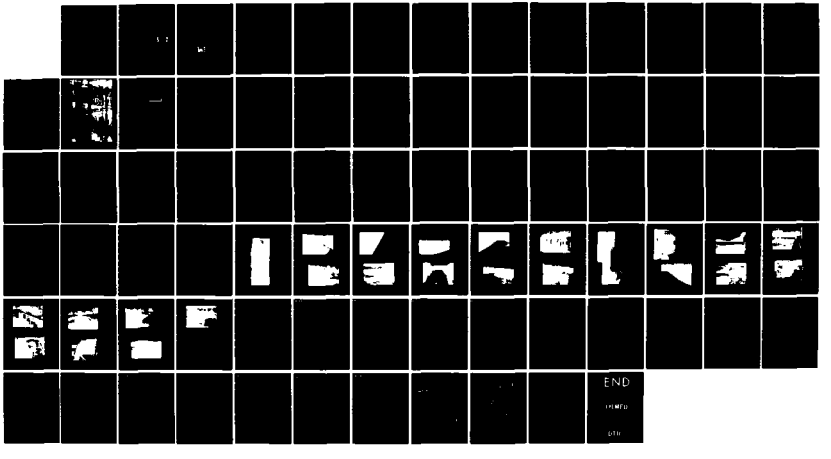
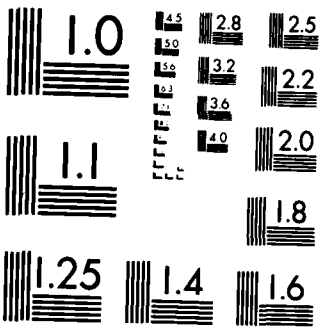
AD-A155 014 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS SEWALLS FALLS DAM (NH.. (U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV MAY 79 1/1

UNCLASSIFIED F/G 13/13 NL





AD-A155 014

DTIC ACCESSION NUMBER

II

LEVEL

PHOTOGRAPH THIS SHEET

SEWALLS FALLS DAM

NH 00091

NHWRB NO. 51.01

1

INVENTORY

DOCUMENT IDENTIFICATION

MAY 1979

This document has been approved for public release and sale; its distribution is unlimited.

DISTRIBUTION STATEMENT

ACCESSION FOR		
NTIS	GRA&I	X
DTIC	TAB	☐
UNANNOUNCED		☐
JUSTIFICATION		
BY		
DISTRIBUTION /		
AVAILABILITY CODES		
DIST	AVAIL AND/OR SPECIAL	
A-1		

DISTRIBUTION STAMP

Copy available to DTIC does not permit fully legible reproduction

DTIC ELECTE JUN 10 1985 S D

DATE ACCESSIONED

DATE RETURNED

85 06 12 018

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NO.

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDAC

DTIC FORM 70A DEC 83

DOCUMENT PROCESSING SHEET

PREVIOUS EDITION MAY BE USED UNTIL STOCK IS EXHAUSTED.

MERRIMACK RIVER BASIN

CONCORD NEW HAMPSHIRE

SEWALLS FALLS DAM

NH 00091

NHWRB NO.51.01

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

MAY 1979

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NH 00091	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Sewalls Falls Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE May 1979 13. NUMBER OF PAGES 76
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Concord, New Hampshire
Merrimack River

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The dam is a run of the river type dam. It is 633 ft. long with a maximum height of 35.9 ft. The visual inspection of the dam revealed that the dam is in generally fair condition. Noted were some minor cracking and spalling of concrete on the abutments and the poor condition of the gates and mechanical operators. It is intermediate in size with a significant hazard potential.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SEWALLS FALLS DAM

NH 00091

NHWRB 51.01

MERRIMACK RIVER BASIN
CONCORD, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LETTER OF TRANSMITTAL

FROM THE CORPS OF ENGINEERS TO THE STATE

TO BE SUPPLIED BY THE CORPS OF ENGINEERS

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.:	00091
Name of Dam:	Sewalls Falls Dam
Town:	Concord
County and State:	Merrimack, New Hampshire
Stream:	Merrimack River
Date of Inspection:	April 20, 1979

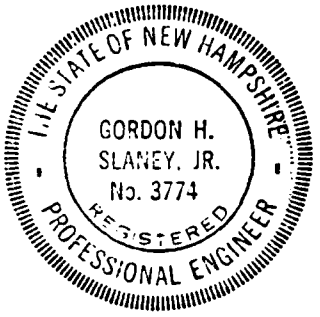
Sewalls Falls Dam is a "run of the river" type dam. Overall length of the dam is 633 feet with a maximum height of 35.9 feet. The 497 foot long spillway is a timber deck/crib type structure constructed on three levels. The dam was originally constructed in 1892. There are no details of any later modifications to the dam. Engineering data available consists of a set of plans dated September-December, 1942, showing an overall plan view of the site, plan and cross sections of the spillway and details of the appurtenant structures. No construction specifications or design calculations were available.

The visual inspection of the dam revealed that the dam is generally in fair condition. The inspection revealed the loss of some timber deck/cribbing from the first apron of the spillway. The extent of the loss of the timber deck/cribbing could not be determined due to the high water level. Also noted were minor cracking and spalling of concrete on the abutments and the poor condition of the gates and mechanical operators.

Based on the dam's intermediate size and significant hazard classification in accordance with Corps of Engineers guidelines, the test flood is one half the Probable Maximum Flood (PMF). The test flood outflow does not overtop the dam. The spillway will pass 100 percent of the routed test flood outflow.

It is recommended that the owner engage a qualified engineer to further investigate the condition of the timber deck/crib spillway at a time when no water is flowing over the spillway. Also, the owner should repair the minor cracks and spalling of the concrete on the abutments in addition to investigating means of making the gates on the power diversion canal operable.

The recommendations and remedial measures described in Section 7 should be addressed within one (1) year after receipt of this Phase I - Inspection Report by the owner.



Gordon H. Slaney, Jr.

Gordon H. Slaney, Jr., P.E.
Project Engineer

Howard, Needles, Tammen & Bergendoff
Boston, Massachusetts

This Phase I Inspection Report on Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

THIS SHEET TO BE FURNISHED BY THE CORPS OF ENGINEERS

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there by any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

Section			Page
Letter of Transmittal			
Brief Assessment			
Review Board Page			
Preface			i
Table of Contents			ii-iv
Overview Photo			v
Location Map			vi
		REPORT	
1.	PROJECT INFORMATION		1-1
	1.1	General	1-1
		a. Authority	1-1
		b. Purpose of Inspection	1-1
	1.2	Description of Project	1-1
		a. Location	1-1
		b. Description of Dam and Appurtenances	1-2
		c. Size Classification	1-2
		d. Hazard Classification	1-2
		e. Ownership	1-2
		f. Operator	1-2
		g. Purpose of Dam	1-3
		h. Design and Construction History	1-3
		i. Normal Operational Procedure	1-3
	1.3	Pertinent Data	1-3
2.	ENGINEERING		2-1
	2.1	Design Data	2-1
	2.2	Construction Data	2-1
	2.3	Operation Data	2-1
	2.4	Evaluation of Data	2-1

Section		Page
3.	VISUAL INSPECTION	3-1
	3.1 Findings	3-1
	a. General	3-1
	b. Dam	3-1
	c. Appurtenant Structures	3-2
	d. Reservoir Area	3-3
	e. Downstream Channel	3-3
	3.2 Evaluation	3-3
4.	OPERATIONAL PROCEDURES	4-1
	4.1 Procedures	4-1
	4.2 Maintenance of Dam	4-1
	4.3 Maintenance of Operating Facilities	4-1
	4.4 Description of any Warning System in Effect	4-1
	4.5 Evaluation	4-1
5.	HYDRAULIC/HYDROLOGY	5-1
	5.1 Evaluation of Features	5-1
	a. General	5-1
	b. Design Data	5-1
	c. Experience Data	5-1
	d. Visual Observation	5-1
	e Overtopping Potential	5-1
	f. Failure Analysis	5-2
6.	STRUCTURAL S BILITY	6-1
	6.1 Evaluati of Structural Stability	6-1
	a. Visual Observation	6-1
	b. Design and Construction Data	6-1
	c. Operating Records	6-1
	d. Post-Construction Changes	6-1
	e. Seismic Stability	6-1

SECTION 5
HYDROLOGY & HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. General. The Sewalls Falls Dam is a timber crib with stone fill sturcture 497 feet long with cut granite block abutments to give an overall length of 633 feet. The power diversion channel located on the west bank and associated structures have not been used since the dam passed from ownership by Concord Electric Company (1967) and did not enter into the hydraulic analysis.

The impoundment of water created by the dam was originally used for power generation, however, since the abandonment of the power facilities there is no specific use for the impounded waters. Sewalls Falls Dam is classified as intermediate in size having a maximum storage of 3,800 acre-feet.

b. Design Data. No hydrologic or hydraulic design data were disclosed for Sewalls Falls Dam.

c. Experience Data. The 1936 flood produced an estimated discharge of 115,000 cfs at Sewalls Falls. Flood elevations were recorded giving a headwater on the dam of 257.6 feet and a tailwater of 248.2 feet. Since the 1936 Flood, the Merrimack basin has experienced the construction of a large number of flood control projects. A report entitled "Water Resource Investigation, Merrimack River Basin" COE, NED, August 1972, predicts the discharge expected from various floods for both natural and regulated conditions.

d. Visual Observations. There was no evidence of damage to any portion of the project from overtopping visible at the time of inspection. However, it was noted that much of the timber cribbing of the first apron was missing, with only three short sections visible across the dam. The extent of the "lost" cribbing could not be determined due to the high water level.

e. Test Flood Analysis. As no detailed design and operational information are available, hydrologic evaluation was performed using dam information gathered by field inspection, watershed size and an estimated test flood equal to ½ the Probable Maximum Flood (PMF). As there is a detailed hydrologic study of the Merrimack River Basin (Water Resources Investigation Merrimack River Basin, New England Division, Corps of Engineers, August 1972) discharge at Sewalls Falls Dam was estimated to equal the Standard Project Flood, modified by existing Corps of Engineers Reservoir systems.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedure

At the present time there is no specific use for the waters impounded by Sewalls Falls Dam. The water level in the reservoir is left to maintain its own stage with only the spillway crest as a control. The headgates to the power diversion canal are not used.

4.2 Maintenance of Dam

The dam is visited about once every two weeks by personel of the New Hampshire Water Resources Board. During the visits the area is checked and the grass cut as necessary.

4.3 Maintenance of Operating Facilities

There is no regular maintenance for the operating facilities. Most of the gates are inoperable at this time.

4.4 Description of Warning Systems

There are no warning systems in effect at this facility.

4.5 Evaluation

The current operation and maintenance procedures for this dam are inadequate to insure that all problems encountered can be remedied within a reasonable period of time. The owner should establish a written operation and maintenance procedure as well as establishing a warning system to follow in event of flood flow conditions or imminent dam failure.

The design drawings indicate that there is a core wall/ cutoff wall from the headgate structure to the powerhouse structure between the canal and the Merrimack River. The cutoff wall near the powerhouse structure could be seen at the time of inspection, but the core wall could not be seen. The depths of the core wall and cutoff wall are not known.

The now abandoned generating station is located at the end of the diversion channel. Visual inspection revealed that all structures related to the generating station are generally in fair to poor condition. The poor condition, as can be seen on Photo Nos. 19,20 and 22, apply primarily to the 50 foot long waste spillway and service bridge.

Water was passing through the wasteway at the downstream end of the canal at the time of inspection. The discharge channel downstream of the wasteway is shown in photo 25. The silt and sand bottom of the discharge channel was very soft. A small spring could be seen in the discharge channel floor in one location near the wasteway.

d. Reservoir Area. As this is a "run of the river" type dam there is virtually no reservoir. The river banks upstream of the dam are heavily wooded with no structures in the immediate area.

e. Downstream Channel. The channel downstream of the dam is about 500 feet wide with a wooded shore line. Other than the powerhouse and outlet works there are no other structures in the immediate area. The downstream channel is the natural river bed. No significant obstructions existed in the channel at the time of inspection.

3.2 Evaluation

Visual inspection indicates that the dam is in fair condition.

The inspection revealed the following:

1. Water over the spillway section prevented a thorough inspection of that section of the dam.

2. Loss of some timber cribbing/deck on the first apron of the spillway.

3. Minor cracking and spalling of concrete at construction joints for the abutments.

4. Inoperable gates at the intake structure for the power diversion canal.

5. Concrete in poor condition for the 50 foot long waste weir and abutment at the power house.

The left wall of the dam is shown in photo 12. From a distance, this wall and the heavy rip-rap downstream of the wall appeared to be in good condition.

The heavy rip-rap downstream of the right wall of the dam was examined and appeared to be in excellent condition, photo 13.

c. Appurtenant Structure. Visual inspection of the timber crib/stone fill spillway, abutments with training and cut-off walls, intake structure to the power diversion channel and the now abandoned generating station did not reveal any evidence of stability problems. Abutment fascias with cut granite masonry are in good condition. The concrete surface, with exception of the abutments and cut-off walls, is in fair to poor condition; cracks and heavy spalling were noted on most of these surfaces. (Photo Nos. 2,11,19,20 and 22.)

The intake structure at the power diversion channel consists of a massive cut granite structure and five (5) brick arch conduits with wooden gates. The intake structure is located at the right abutment. The gates, as originally designed, were operated by an electromechanical control system. Visual inspection revealed that the gate house and electrical equipment have been completely destroyed; mechanical controls are in very poor condition. The brick arch conduits to the power diversion channel were not inspected as they were partially below water level. The roof structure of these conduits appeared to be in good condition as can be seen on Photo No. 5. The downstream end of the headgate structure is shown in Photo No. 5. The intake channel to the headgates is shown in Photo No. 6. The stone masonry forming the headgate structure appeared to be in excellent condition with the exception of minor amounts of mortar missing in several areas.

The power diversion channel consists of a 1280 feet long channel between the intake structure and the now abandoned generating station, see Photo Nos. 7 and 21.

The sidewalls of the canal appeared to be in horizontal and vertical alignment above the water line at the time of inspection. Design drawings show that the walls on both sides are 12 feet in height and composed of 3 inch sheet pilings. The type of piling is unknown. The left wall is tied back near its top by a 10 foot long iron rod which is embedded in a reinforced concrete anchor at its end. The design drawings indicate that in back of the right canal wall and near its top there is an earth filled timber cribbing structure which is about 4.5 feet in height. Apparently, the right canal wall is attached to the timber cribbing. The power diversion channel is in good condition.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Sewalls Falls Dam was made on April 20, 1979. The inspection team consisted of personnel from Howard, Needles, Tammen & Bergendoff and Geotechnical Engineers, Inc. Inspection checklists, completed during the visual inspection, are included in Appendix A. At the time of the inspection the water level was approximately 2.0 feet above the spillway crest. Only portions of the dam above the water level could be inspected.

b. Dam. Visual inspection of the dam indicated that the visible portions of the dam were generally in good condition. However, the condition of the spillway which constitutes a major portion of the dam could not be fully determined due to the high water. There are indications that the spillway may be in fair to poor condition.

The dam is comprised of timber cribbing filled with hand packed stone filling. Water of the Merrimack River flows over the entire crest of the spillway; the crest is 497 feet in length. A headgate structure to the right of the dam controls flow of water into a canal which leads to the power house structure.

The spillway section consists of a timber crib/deck and stone structure, shaped as shown on Section A-A, Figure 1, located in Appendix B. The spillway structure extends through the entire width of the Merrimack River. On the day of inspection the entire spillway structure was under water, with approximately 2 feet of water over the spillway crest (see Photo No. 4). The crest of the spillway structure was visible and appeared to be in good condition.

There were however indications, by observing flow of the tailwater, that portions of the timber crib/deck structure in the first apron, were damaged. However, it was not possible to determine the extent of the damage due to the water flowing over the spillway. It was reported by the owner that the lower portions of the spillway were in poor condition.

The elevation of water after passing the crest is higher at the right end of the dam as shown in photo 8. The reason for this difference is unknown.

The abutments, consisting of cut granite fascias and concrete cut-off walls, are generally in good condition, except for some cracks and concrete spalling at the construction joints, see Photo No. 2.

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data were disclosed for Sewalls Falls Dam. Original construction of this dam was completed in 1892. Extensive repairs to the dam were made in 1933 and 1934, however, the exact nature of the repairs was not disclosed. Plans showing the dam and appurtenances were made available.

2.2 Construction

No construction records were available for use in evaluating the dam.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

a. Availability. Engineering data available for Sewalls Falls Dam is limited to the plans mentioned above. These plans are on file at the New Hampshire Water Resources Board, Concord, New Hampshire.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. The field investigation indicated that external features of Sewalls Falls Dam substantially agree with those shown on the available plans.

(4) Top Width -12.0 foot wide crest to spillway which is main portion of dam

(5) Side Slopes - US = 4:1; DS = stepped.

(6) Zoning - unknown.

(7) Impervious core - N/A.

(8) Cutoff - unknown.

(9) Grout Curtain - unknown.

(10) Other - unknown.

h. Diversion and Regulating Channel

See Section j below.

i. Spillway

(1) Type - timber crib 12' wide at top.

(2) Length of Weir - 497 feet.

(3) Crest Elevation - 240.9.

(4) Gates - none.

(5) U/S Channel - Natural River Channel.

(6) Downstream Channel. The channel downstream of the dam is about 500 feet wide with a wooded shore line. Other than the power house and outlet works there are no other structures in the immediate area.

j. Regulating Outlets. The power canal level is regulated at the upstream end by five 107 square foot openings controlled separately by mechanically operated gates. At the downstream end of the canal, flow can be routed through the power building (inoperable at present) over a 50 long waste weir with its crest at 242.86 feet, through a 10 foot by 8'-6" wasteway gate invert 235.86 or a 6'-6" by 4'-8" bleeder gate invert 225.86. With the water surface on the spillway crest elevation the capacity of the outlet works is about 880 cfs.

(5) Full flood control pool - N/A.

(6) Spillway crest (permanent spillway) - 240.9.

(7) Design surcharge - unknown.

(8) Top Dam - 259.1

(9) Test Flood Surcharge - 253.8

d. Reservoir (miles)

(1) Length of Maximum Pool - N/A.

(2) Length of Recreational Pool - N/A.

(3) Length of Flood Control Pool - N/A.

e. Storage (Acre-Feet)

(1) Recreation Pool - N/A.

(2) Flood Control Pool - N/A.

(3) Spillway Crest Pool - 3,070.

(4) Top of Dam - Unknown

f. Reservoir Surface (Acres)

(1) Recreation Pool - N/A.

(2) Flood Control Pool - N/A.

(3) Spillway Crest - 350.

(4) Test Flood Pool - 350.

(5) Top Dam - 350.

g. Dam

(1) Type - timber crib.

(2) Length - 633 feet, overall.

(3) Height - 35.9 feet (maximum).

g. Purpose of Dam. Originally, this dam was used for power generation by the Concord Electric Company. At the present time there is no specific use for the water impounded by the dam.

1.3 Pertinent Data

a. Drainage Area. The drainage area tributary to Sewalls Falls Dam consists of 2,233 square miles of terrain varying from flat to mountainous. Major tributaries to the Merrimack River Above this point include the Contoocook River, Winnipesaukee River and the Pemigewassit River. The basin is regulated by many large reservoirs which include: Franklin Falls, Hopkinton-Everett, Blackwater Reservoir, Edward MacDowell Reservoir, and Newfound Lake. These Corps of Engineers reservoirs provide a large potential for flood regulation.

As the Sewalls Falls Dam is a "run of the river" type dam, the reservoir impounded by it is small.

b. Discharge at Dam Site

(1) Outlet works for the dam consist of a 1,280 foot long power canal regulated at its head by five 10 foot wide gates at invert elevation 229.96. Capacity of the outlet works including the gates at the power house is approximately 880 cfs with the water surface at the spillway crest. At the powerhouse, there is a 10 by 8.5 foot waste gate at invert 235.86 and a 6.5 by 4.7 foot bleeder gate at invert 225.86.

(2) The maximum discharge at the site is estimated to by 115,000 cfs based on a recorded discharge of 122,000 cfs at Garvins Falls 11 miles downstream in March of 1936. A headwater of 257.6 feet and a tailwater of 248.2 feet was recorded at Sewalls Falls in March of 1936. It is predicted that a repeat of the 1936 flood, with flood control regulation, would produce a discharge of 57,000 cfs at Garvins Falls.

(3) The spillway capacity with a water surface at the top of dam (elevation 259.1) is approximately 145,300 cfs.

(4) The spillway capacity with the water surface at the test flood elevation of 253.8 feet is approximately 86,550 cfs.

(5) The total project discharge at the test flood elevation of 253.8 feet is approximately 86,550 cfs.

c. Elevation (feet above MSL)

(1) Streambed at centerline of dam - 223.2±

(2) Maximum tailwater - 248.2 (1936 flood).

(3) Upstream portal invert diversion channel - 229.96.

(4) Recreational pool - N/A

b. Description of Dam and Appurtenances. Sewalls Falls Dam is a "run of the river" type dam. Overall length of the dam, according to the plans is 633 feet. The 497 foot long timber crib and stone fill spillway was constructed on three levels, crest, first apron and second apron. According to the plans, the timber cribbing has a vertical upstream face with stone and gravel fill placed to within several feet of the crest on a 4 horizontal to 1 vertical slope. Abutments are constructed of cut granite masonry. The west abutment is extended 130 feet downstream with a cut granite block rip-rap, stepped on approximately a 1:1 slope. The east abutment is continued by approximately 40 feet of cut granite block rip-rap.

Head gates to a power diversion channel are located west of the end of the west abutment. There are five 10 foot wide gates which lead to a 1,280 foot long diversion channel. The now abandoned generating station is located at the end of the diversion channel. In addition to the 7 penstock gates indicated on the plans, there is a 50 foot waste weir and 2 control gates.

Figures 1 and 2 located in Appendix B, show the plan of the dam and appurtenant structures. Photographs of each structure are shown in appendix C.

c. Size Classification. Intermediate (Hydraulic height-35.9 feet, storage - 3,800 acre-feet) classification based on storage being between 1,000 and 50,000) acre-feet as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The hazard to life and property poised by this dam is classified as significant. A major breach of dam (when the upstream pool elevation is at the top of dam) would result in a maximum rise of 1.6 feet in downstream water level through Concord. This additional rise in water surface will further inundate an already flooded, highly developed area and will probably expand the flood hazard area. The downstream stage, prior to breach of dam, would also present a great hazard to life and property.

e. Ownership. This dam is now owned by the New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire. Prior to 1967 the dam was owned by Concord Electric Company.

f. Operator. This dam is maintained and operated by the New Hampshire Water Resources Board. Chairman of the Water Resources Board is Mr. George M. McGee, Sr.; Mr. Vernon Knowlton is Chief Engineer, Telephone No. 603/271-1110.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
SEWALLS FALLS DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Howard, Needles, Tammen & Bergendoff has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Howard, Needles, Tammen & Bergendoff under a letter of October 23, 1978 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0356 has been assigned by the Corps of Engineers for this work.

b. Purpose

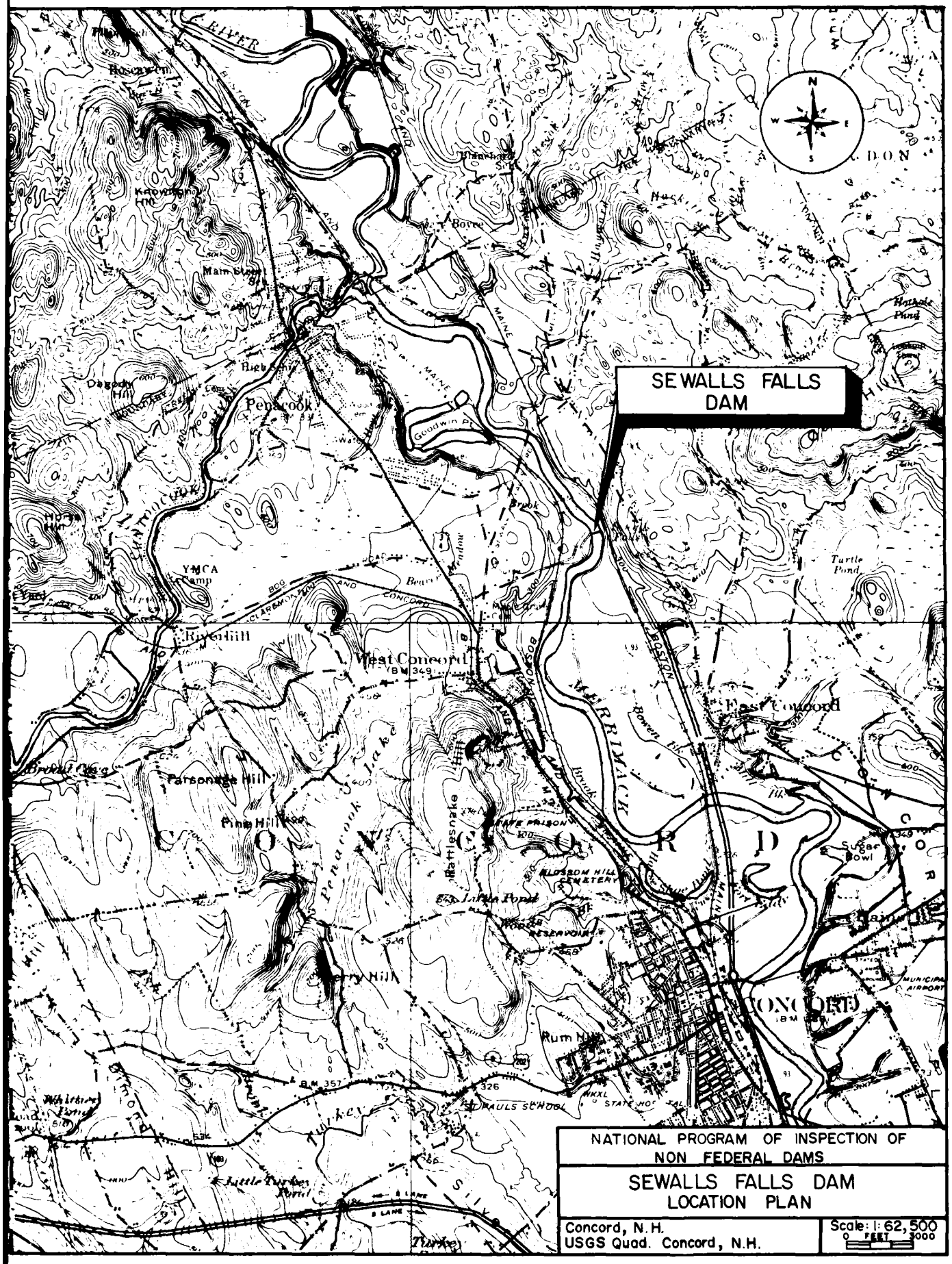
(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Sewalls Falls Dam is located along the Merrimack River approximately 2.5 miles downstream of its confluence with the Contoocook River in Corcord, New Hampshire. The dam is shown on U.S.G.S. Quadrangle Penacook, New Hampshire with approximate coodinates N43° 15' 40", W71° 33' 10", Merrimack County, New Hampshire. The dam location is shown on the preceding page.

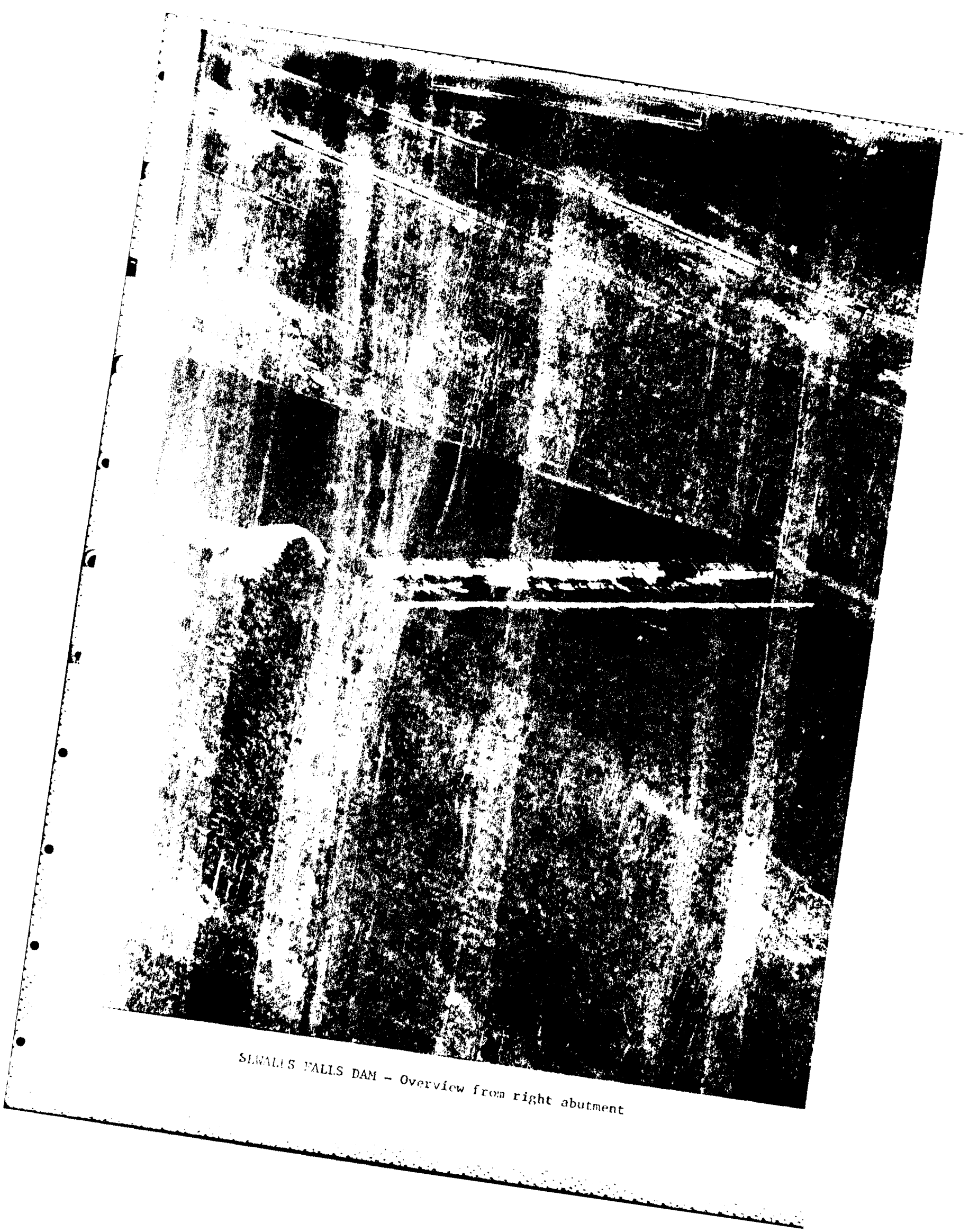


NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

SEWALLS FALLS DAM
LOCATION PLAN

Concord, N.H.
USGS Quad. Concord, N.H.

Scale: 1: 62,500
0 FEET 3000



SIWALLS FALLS DAM – Overview from right abutment

Section		Page
7.	ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES	7-1
7.1	Dam Assessment	7-1
	a. Condition	7-1
	b. Adequacy of Information	7-1
	c. Urgency	7-1
	d. Need for Additional Investigation	7-1
7.2	Recommendations	7-2
7.3	Remedial Measures	7-2
7.4	Alternatives	7-2

APPENDIXES

APPENDIX A - INSPECTION CHECKLIST

APPENDIX B - ENGINEERING DATA

APPENDIX C - PHOTOGRAPHS

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

Based on a drainage area of 2,233 square miles, the test flood inflow was estimated to be 86,900 cfs. Following the guidance of Estimating Effect of Surcharge Storage on Probable Maximum Discharge results in a test flood outflow of 86,550 cfs. As the maximum capacity of the spillway is 145,300 cfs, the spillway can pass 100 percent of the routed test flood outflow.

f. Dam Failure Analysis. The impact of failure of the dam at maximum pool (top of dam) was assessed using the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to a point 10.4 miles downstream in Concord, New Hampshire.

Failure of Sewalls Falls Dam with the pool at the top of dam results in an increase of 1.6 feet in the downstream stage or from 30 feet to 31.6 feet. The 1.6 foot increase will be lowered to a 0.9 foot increase 3 miles downstream and 0.6 feet 10.4 miles downstream due to channel storage. It is considered that a stage of 30 feet, which represents the maximum spillway flow, would be a major flood. An additional rise of 1.6 feet from the breach of dam would most likely produce additional property damage in the highly developed commercial and residential areas on the flood plain in Concord. The marginal difference in hazard to life could not be considered high.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. The visual observations did not disclose any immediate stability problems, however, a thorough visual inspection of the spillway could not be made because of water flow over the crest.

b. Design and Construction Data. Design drawings of Sewalls Falls Dam dated September - December, 1942 are available.

Information on these drawings include:

1. Plan view of dam and outlet works.

2. Plan view of core wall and cutoff wall between the headgate structure and powerhouse structure.

3. Plan views and cross sections through the dam. The dam consists of timber cribbings fitted with "hand packed" stone. The dam is founded on "hardpan". A cross sectional drawing of the dam indicates 3" and 4" sheet piling at four locations beneath the dam and parallel to the dam's longitudinal axis. No depths are given for the sheet piling.

4. A 4 horizontal to 1 vertical slope of stone and gravel rests against the upstream face of the timber cribbing.

5. Design details of the left and right walls of the canal are given. The tieback systems for the walls are given.

c. Operating Records. No operating records were made available.

d. Post-Construction Changes. The original dam was built in 1892. Documentation of the dam history since 1892 is too vague to determine if significant changes were made to the dam after construction.

e. Seismic Stability. The dam is located in Seismic Zone 2, and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATION AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection of Sewalls Falls Dam indicates that the dam is in fair condition in so far as the portions seen during the inspection are concerned. A complete assessment of the spillway section could not be made due to high water. The inspection revealed the following:

(1) Loss of some timber deck/cribbing on the first apron of the spillway.

(2) Minor cracking and spalling of concrete at construction joints for the abutments.

(3) Inoperable gates at the intake structure for the power diversion canal.

(4) Concrete in poor condition for the 50 foot long waste weir and abutment at the power house.

The hydraulic analysis reveals that the spillway can pass the routed test flood without overtopping of the dam.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency. This dam is in generally fair condition. The recommendations described in Section 7.2 and the remedial measures described in Section 7.3 should be accomplished within 1 year, unless otherwise noted, after receipt of this Phase I Inspection Report by the owner.

d. Necessity of Additional Investigation. Due to the high water over the spillway section of the dam the extent of the loss of timber deck/cribbing could not be fully determined. Some means of reducing or diverting the flow over the spillway should be devised in order to allow for a complete examination.

7.2 Recommendations

It is recommended that the owner engage a qualified engineer to further investigate the condition of the timber deck/cribbing spillway at a time when no water is flowing over the spillway.

7.3 Remedial Measures

(a) Minor cracking and spalling of concrete at construction joints for the abutments should be repaired.

(b) A means for making the control gates operable on the power diversion canal should be investigated.

(c) A written operational procedure and warning system to follow in the event of flood flow conditions or imminent dam failure should be developed.

(d) Initiate a program of annual periodic technical inspection.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT SEWALL FALLS DAM

DATE April 20, 1979

TIME 11:00 AM

WEATHER Fair 50°F

W.S. ELEV. 242.9 U.S. - DN.S

PARTY:

1. D. LaGatta GEI
2. S. Mazur HNTB
3. R.A. Yarsites HNTB
4. T. Keller GEI
5.
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam	Dan LaGatta, Tom Keller	
2.	Spillway, Outlet and	Stan Mazur, R. Yarsites	
3.	Downstream Channel		
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT SEWALLS FALLS DAM — DATE April 20, 1979

PROJECT FEATURE Timber Crib - Stone Filled — NAME D. P. LaGatta

DISCIPLINE Geotechnical Engineer — NAME T. O. Keller

AREA EVALUATED	CONDITION
DAM EMBANKMENT	Dam was covered with water of Merrimack River. Comments are made for those aspects which could be seen.
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	No pavement.
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	Right abutment wall in good condition.
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	None.
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	Riprap on abutments in excellent condition.
Unusual Movement or Cracking at or near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	None observed.
Vegetation	None of significance.

PERIODIC INSPECTION CHECK LIST A-3

PROJECT SEWALLS FALLS DAM DATE April 20, 1979

PROJECT FEATURE Intake Channel Structure NAME D. P. LaGatta, T.K.

DISCIPLINE Geotechnical/Hydrolic/Structure NAME S. M. & R. Y.

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Stone masonry and wood planks forming walls in good condition.
Slope Conditions	
Bottcm Conditions	Bottom not visible.
Rock Slides or Falls	None
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	None observed.
b. Intake Structure	This facility has only power intake structure consisting granite blocks structure and five (5) brick arch conduits with wooden gates. The intake structure is located at right abutment.
Condition of Concrete	
Stop Logs and Slots	The gates, as originally designed, were operated by the electro-mechanical control system. Visual inspection reveal that the gate house and electrical equipment are completely destroyed; mechanical controls are in very poor condition.

PERIODIC INSPECTION CHECK LIST

PROJECT SEWALLS FALLS DAM — DATE April 20, 1979

PROJECT FEATURE Control Tower — NAME S. Mazur

DISCIPLINE Structural Engineer — NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	This facility has no control tower.
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECK LIST

ROJECT SEWALLS FALLS DAM DATE April 20, 1979

ROJECT FEATURE Transition and Conduit NAME

ISCIPLINE Structural Engineer NAME S. Mazur

AREA EVALUATED	CONDITION
UTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Brick arch conduits (five) from reservoir to the power diversion channel were not inspected as they were partially below water level.
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	The roof structure of these conduits appear to be in good condition as can be seen on photo 5.
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECK LIST

JECT SEWALLS FALLS DAM — DATE April 20, 1979

JECT FEATURE Outlet Structure — NAME D. P. LaGatta, T.K.

CIPLINE — NAME S. Mazur, R. Yarsites

AREA EVALUATED	CONDITION
LET WORKS - OUTLET STRUCTURE AND JTLET CHANNEL	
General Condition of Concrete	Power intake structure which is only way of outletting water other than the spillway consists of five conduits with wooden gates. Wooden gates and control mechanism are in poor condition.
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain Holes	None observed.
Channel	
Loose Rock or Trees Overhanging Channel	Small trees overhanging channel.
Condition of Discharge Channel	Silt and sand bottom of channel is very soft. Observed one small spring in channel floor.

PERIODIC INSPECTION CHECK LIST

:CT SEWALLS FALLS DAM DATE April 20, 1979

:CT FEATURE Spillway/Channel NAME D. LaGatta, T. Keller

:PLINE Structural/Hydraulic/Geotechnical Engineer NAME S. Mazur, R. Yarsites

AREA EVALUATED	CONDITION
:T WORKS - SPILLWAY WEIR, APPROACH DISCHARGE CHANNELS	Entire dam is spillway.
\pproach Channel	
General Condition	
Loose Rock Overhanding Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
Weir and Training Walls	
General Condition of Concrete	Timber - crib/deck Spillway structure; length-full width of Merrimack River with no controls. At the time of inspection approximately 2 feet of water was flowing over the spillway.
Rust or Staining	
Spalling	
Any Visible Reinforcing	Visual inspection appear to indicate that the lower portion of the timber crib/deck structure, in some areas, was partially or completely destroyed.
Any Seepage or Efflorescence	
Drain Holes	
Discharge Channel	Discharge channel is Merrimack River.
General Channel	Excellent - very wide.
Loose Rock Overhanging Channel	None of significance.
Trees Overhanging Channel	None visible - no trees.
Floor of Channel	Not visible - no trees
Other Obstructions	None

PERIODIC INSPECTION CHECK LIST

:CT SEWALLS FALLS DAM DATE April 20, 1979

:CT FEATURE Service Bridge NAME S. Mazur

:PLINE Structural Engineer NAME

AREA EVALUATED	CONDITION
:T WORKS - SERVICE BRIDGE	
;uper Structure	The service bridge over the spillway at the Electric Power Plant. The service Bridge is supported by three(3) steel bents and two (2) concrete abutments. Bridge superstructure is in poor condition.
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	Wooden Planks, fair condition
Deck	
Drainage System	None
Railings	Pipe railing, poor condition.
Expansion Joints	None
Paint	Very poor
Abutment & Piers	
General Condition of Concrete	Poor
Alignment of Abutment	Good
Approach to Bridge	Good
Condition of Seat & Backwall	Fair. Concrete spillway areas which support the steel bents are in very poor condition. (Photos Nos. 19 & 22)

APPENDIX B

ENGINEERING DATA

1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS

2. PAST INSPECTION REPORTS - NONE AVAILABLE

3. PLAN AND DETAILS

PHOTO NO. 17 - View of left abutment.

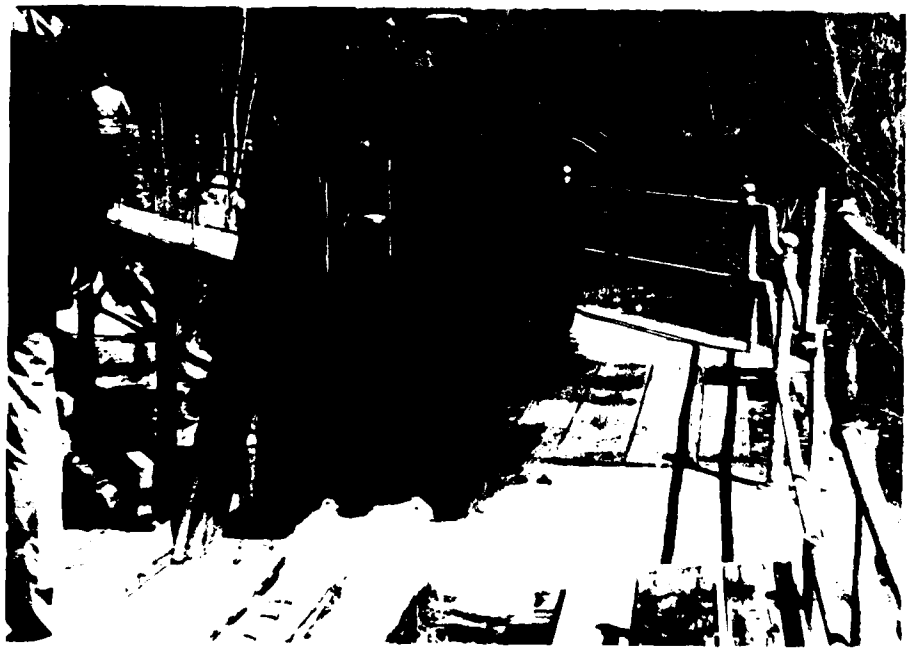


PHOTO NO. 18 - View of operation mechanics for waste-way gate and bleeder gate.

PHOTO NO. 15 - View of spillway and left abutment.

PHOTO NO. 16 - View of left abutment.

PHOTO NO. 13 - View of riprap on right bank downstream of dam.

PHOTO NO. 14 - View of spillway from left abutment.

PHOTO NO. 12 - View of left training wall of spillway.

PHOTO NO. 10 - View of upstream side of head gate structure and operating mechanism.

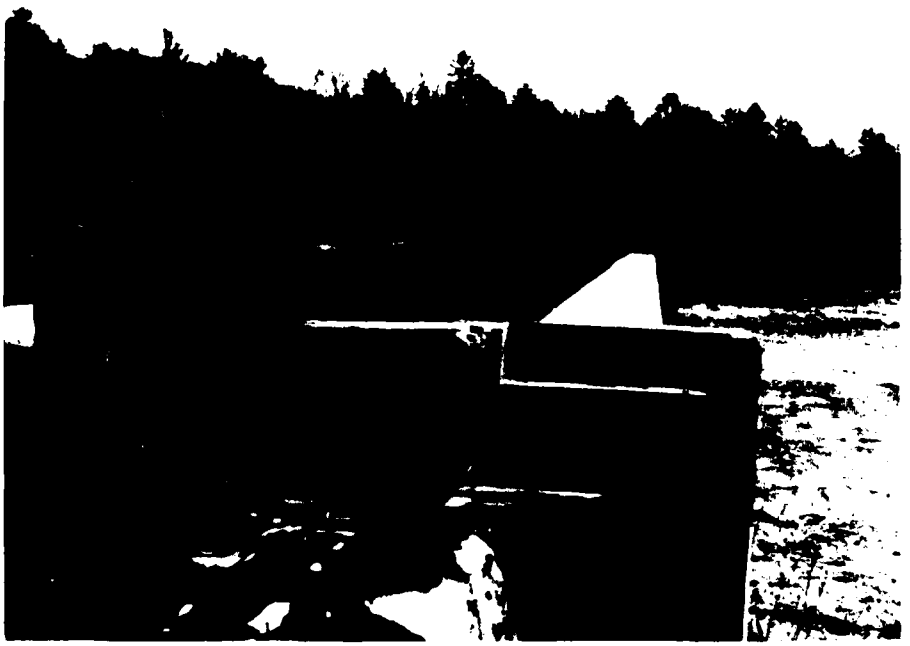


PHOTO NO. 11 - View of operating mechanism for head gates.

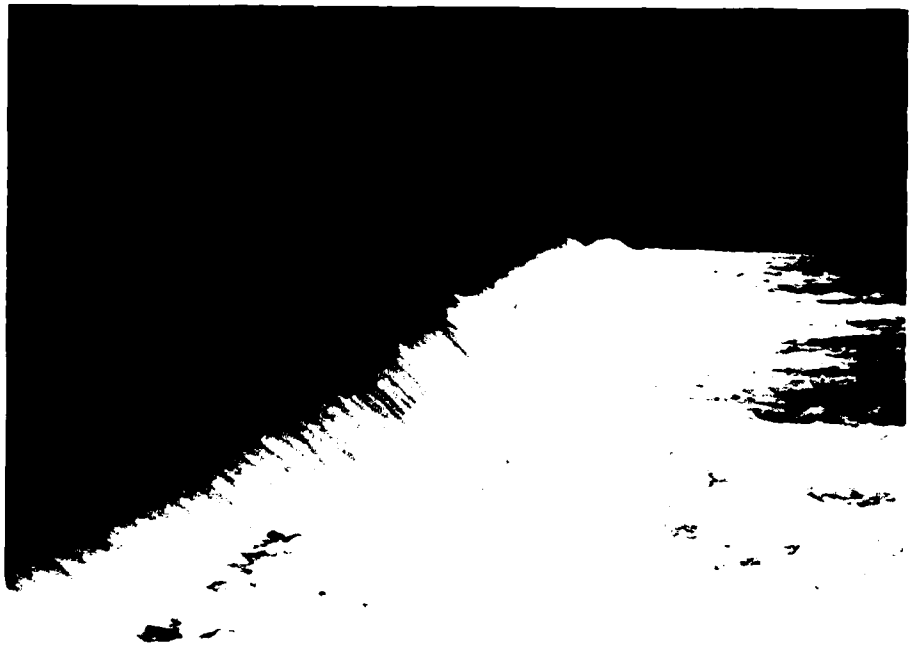


PHOTO NO. 8 - View of spillway and left abutment.

PHOTO NO. 9 - View of downstream channel from right abutment.

PHOTO NO. 6 - View of upstream wall of head gate structure from right bank of intake channel.

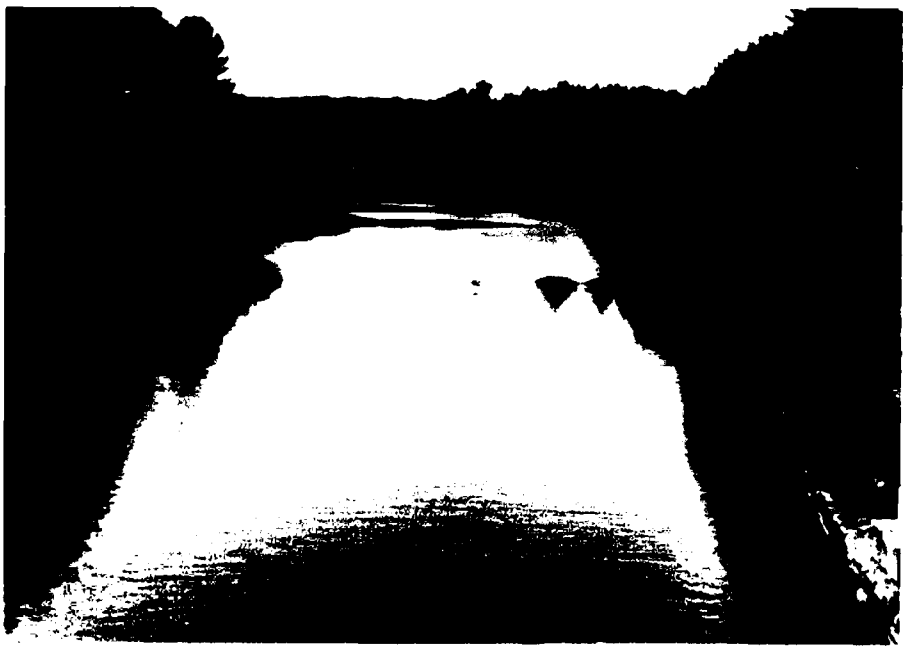


PHOTO NO. 7 - View of power diversion canal looking downstream.

PHOTO NO. 4 - View of crest of timber crib spillway from right abutment.

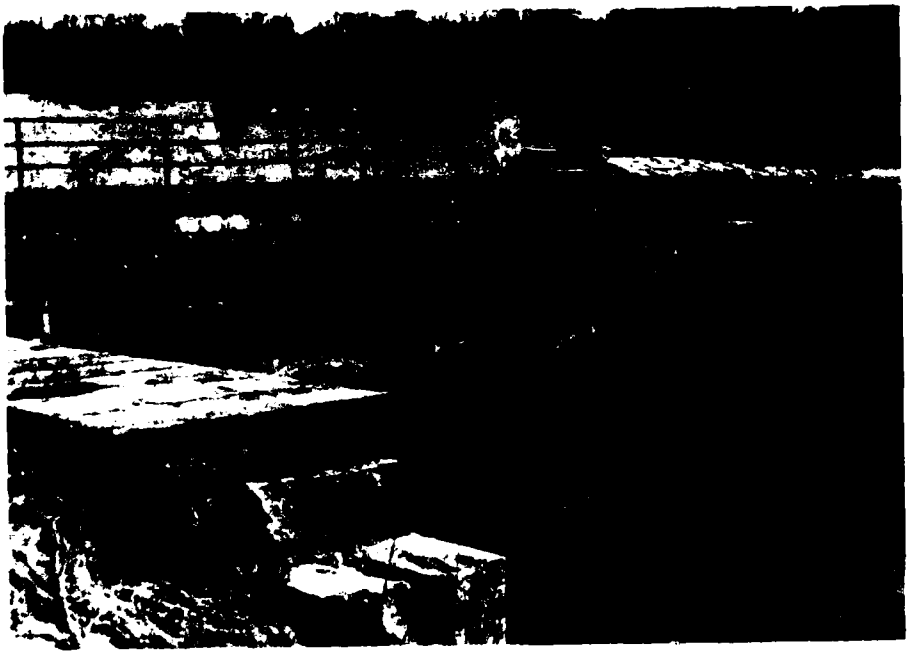


PHOTO NO. 5 - View of downstream side of head gates from right bank of canal.

PHOTO NO. 2 - View of right bank protection wall and abutment.

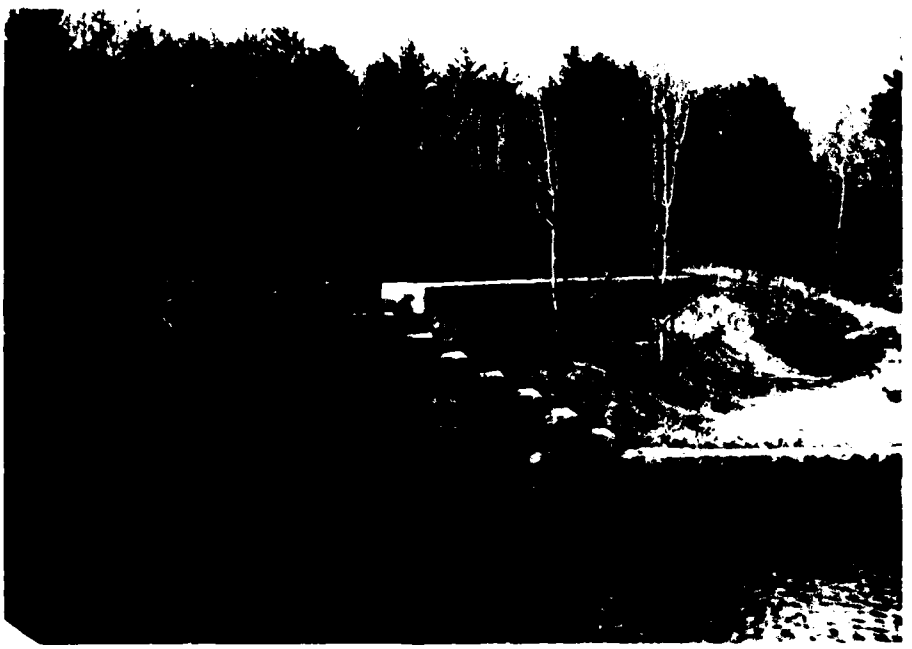


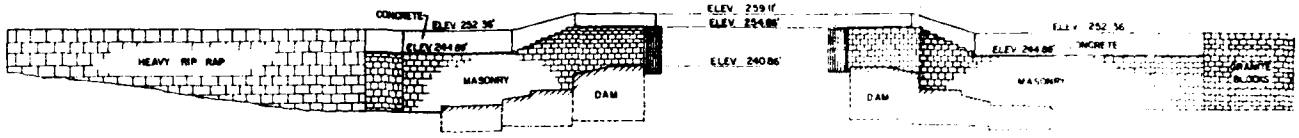
PHOTO NO. 3 - View of head gates and bank protection wall from right abutment.

PHOTO NO. 1 - View of upstream side of dam from right bank.

APPENDIX C

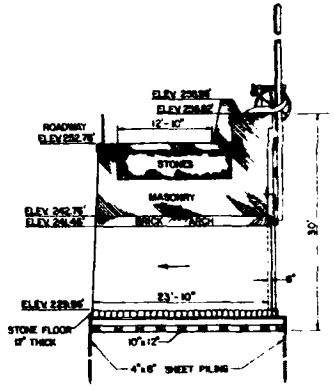
PHOTOGRAPHS

FOR LOCATION OF PHOTOS, SEE FIGURE 1
LOCATED IN APPENDIX B



WEST ABUTMENT

EAST ABUTMENT



SECTION B-B

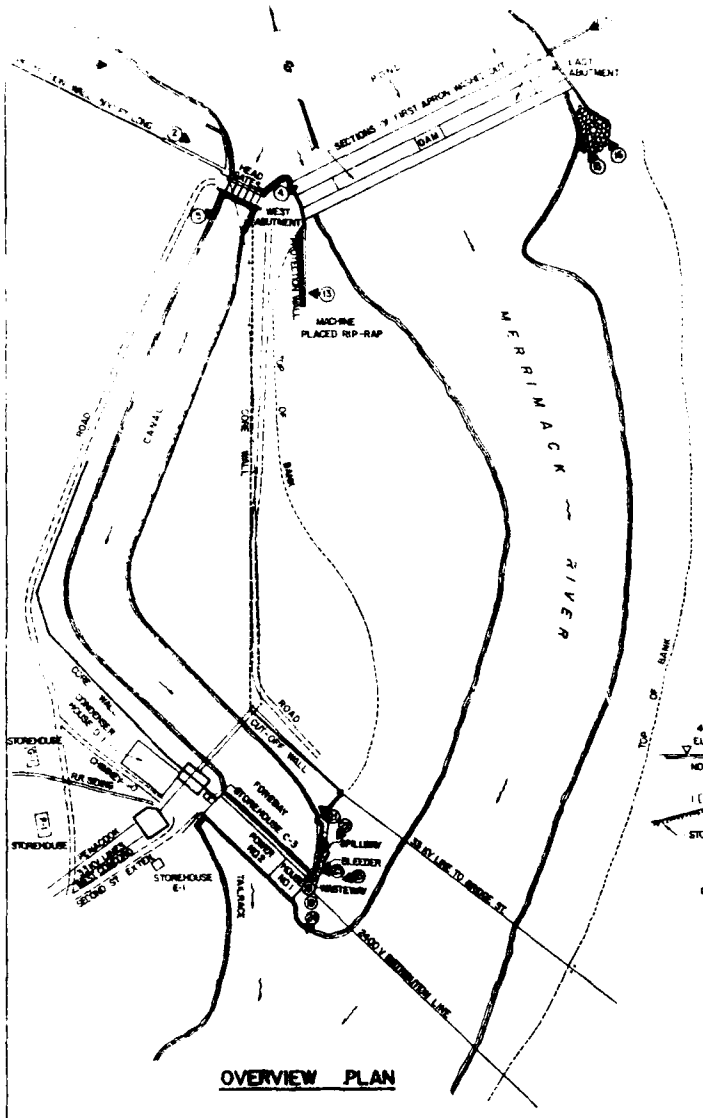
1. THE INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON THE ORIGINAL CONSTRUCTION PLANS AND VISUAL OBSERVATIONS MADE DURING THE FIELD INSPECTION. DIMENSIONS OR MATERIALS INDICATED ON THESE DRAWINGS WHICH WERE BELOW GRADE OR WATER DURING THE TIME OF INSPECTION WERE NOT VERIFIED.
2. THE ELEVATIONS SHOWN ARE [illegible] DATUM.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

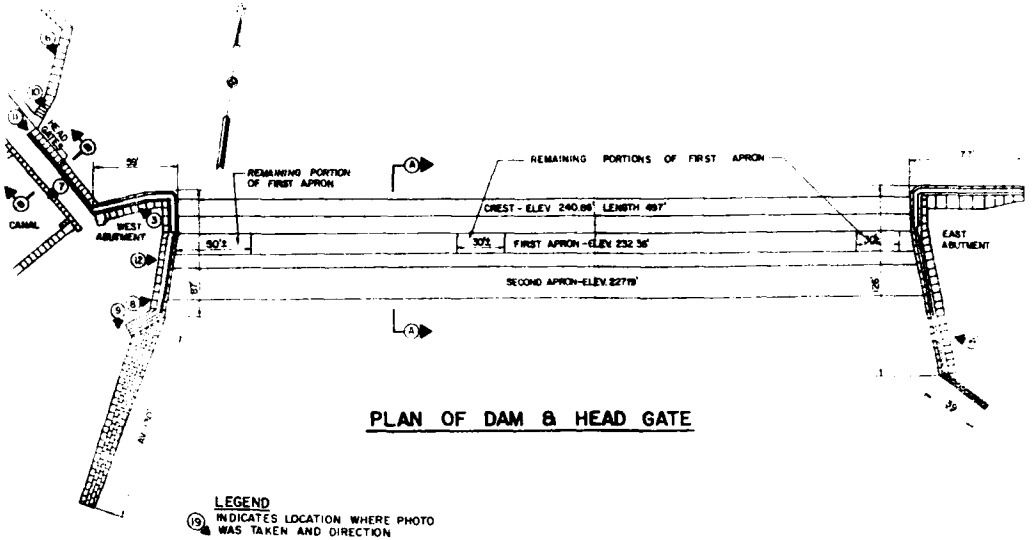
SEWALLS FALLS DAM

MERRIMACK RIVER CONCORD, NEW HAMPSHIRE

Figure 2 of 2

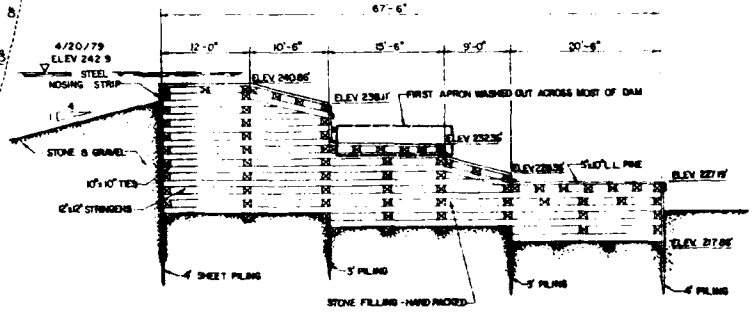


OVERVIEW PLAN



PLAN OF DAM & HEAD GATE

LEGEND
(19) INDICATES LOCATION WHERE PHOTO WAS TAKEN AND DIRECTION



SECTION A-A

1. THE INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON THE ORIGINAL CONSTRUCTION PLANS AND VISUAL OBSERVATIONS MADE DURING THE FIELD INSPECTION. DIMENSIONS OR MATERIALS INDICATED ON THESE DRAWINGS WHICH WERE BELOW GRADE OR WATER DURING THE TIME OF INSPECTION WERE NOT VERIFIED.
2. THE ELEVATIONS SHOWN ARE 1929 M.S.L. DATUM.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SEWALLS FALLS DAM

MERRIMACK RIVER — CONCORD, NEW HAMPSHIRE

Figure 1 of 2

AVAILABLE ENGINEERING DATA

A set of drawings (5 sheets) dated September - December 1942, showing an overall plan of the dam, plan view of the core wall and cut off wall between the headgate structure and powerhouse structure, plan and cross-section views of the timber deck/crib spillway and details of the abutments and outlet works. The plans are available at the State of New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire 03301.

PHOTO NO. 19 - View of waste weir from power house structure.

PHOTO NO. 20 - View of left abutment of waste weir.

PHOTO NO. 21 - View of power diversion canal from power house structure.

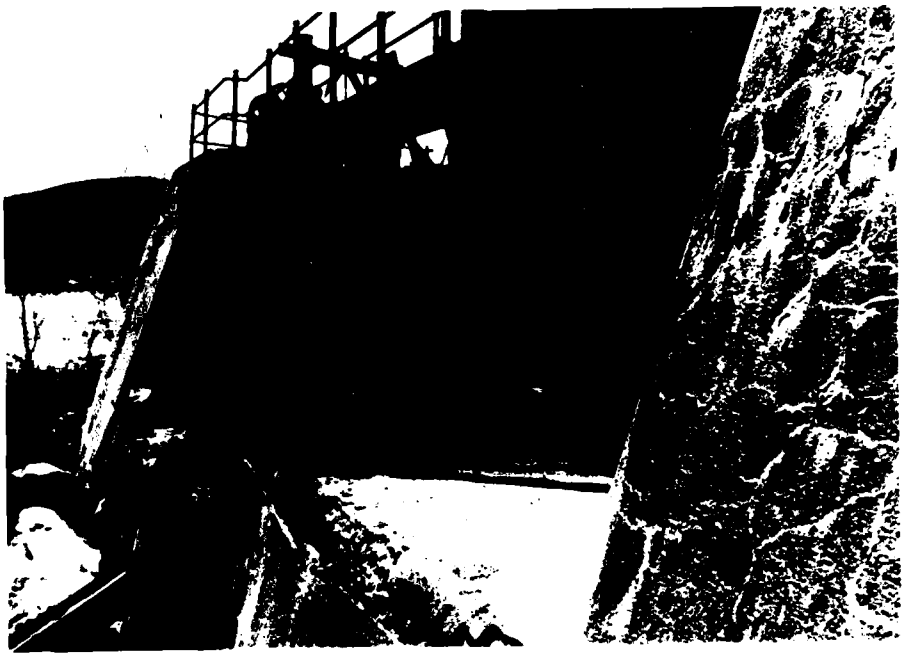


PHOTO NO. 22 - View of downstream side of waste weir.

PHOTO NO. 23 - View of power house from waste weir.

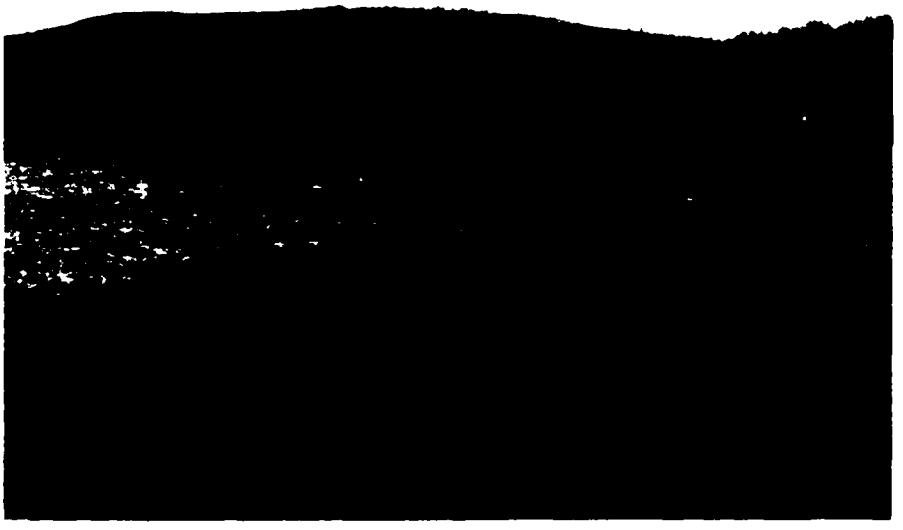


PHOTO NO. 24 - View of river channel downstream of power house.

PHOTO NO. 25 - View of discharge channel downstream of power house structure.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

HNTB
OWARD NEEDLES TAMMEN & BERGENDOFF

Made by	RY	Date	11/20/78	Job No.	5628-11-13
Checked by	MMD	Date	5/15/79	Sheet No.	1

Sewalls Falls Dam

HYDRAULICS & HYDROLOGY

Sewalls Falls Dam located in Concord N.H.

across the Merrimack River

Classification Size : Intermediate
Hazard : significant

Basic Data D.A. = 2233 sq mi checked by HNTB
Upstream basin : flat S = .00026'

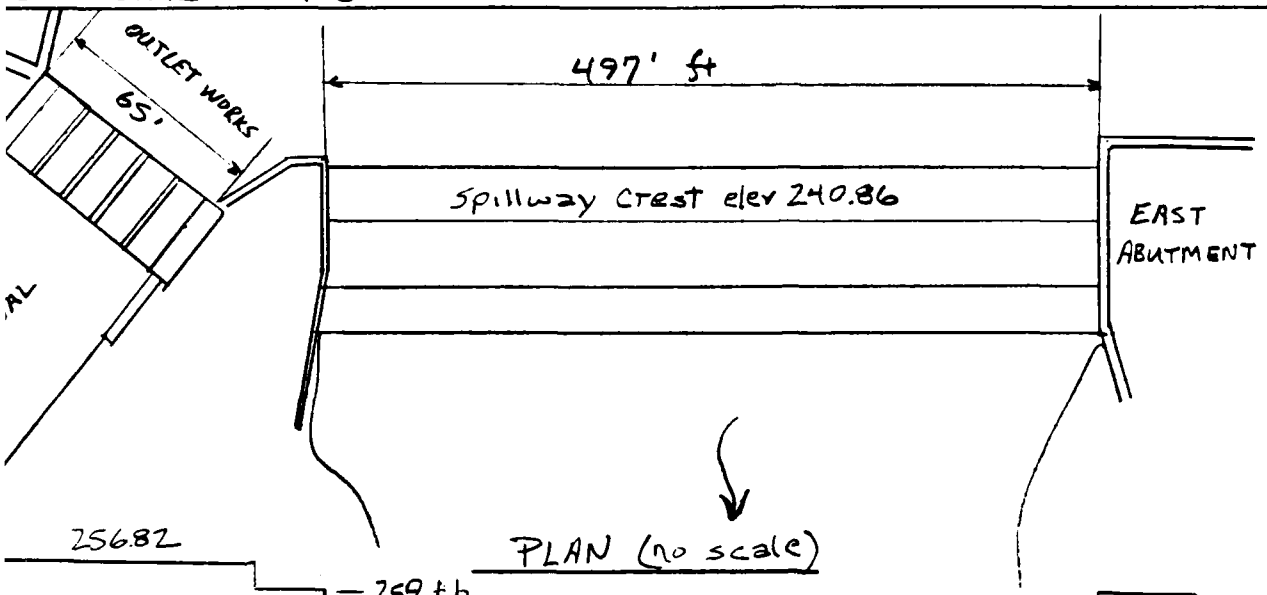
Reservoir : Run of River Type
Normal : Storage: 3070 acre-ft
@ elev. 240.86
Max : storage : unknown

Dam : Timber crib & earth
Length 600' ±
Max height 35.9 ft
Spillway : Timber Crib
Length 497'
Crest elev. 240.86
Outlet works :
Waste weir control 50' Long
crest at 242.86

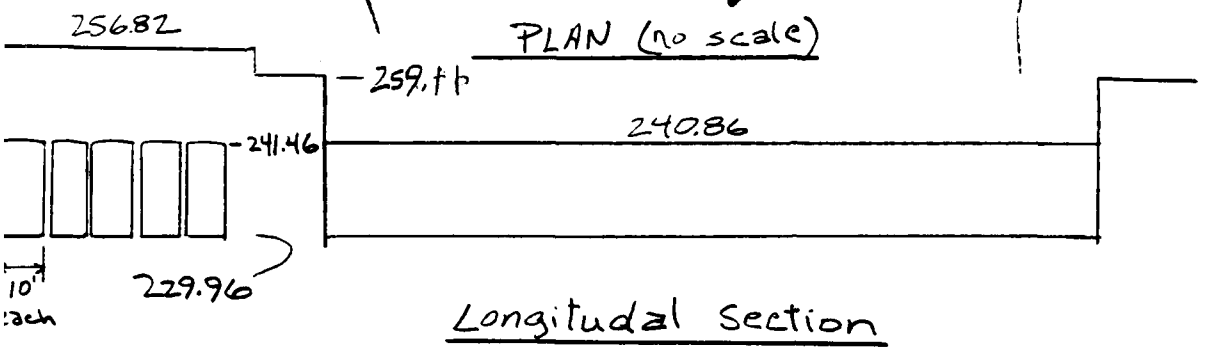
NTB
ARD NEEDLES TAMMEN & BERGENDOFF

Made by	RY	Date	12/4/78	Job No.	5628-11-13
Checked by		Date	5/15/79	Sheet No.	2

Sewalls Falls

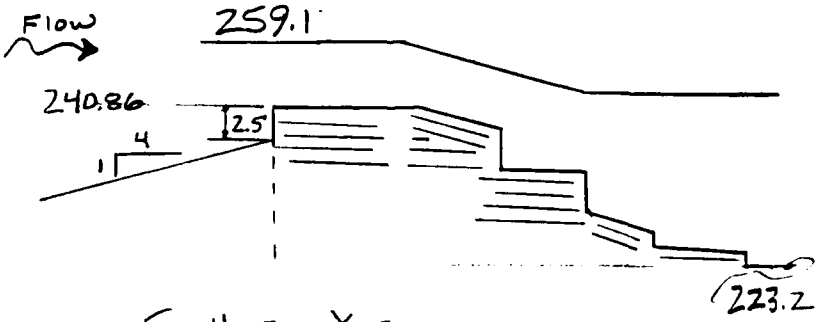


PLAN (no scale)

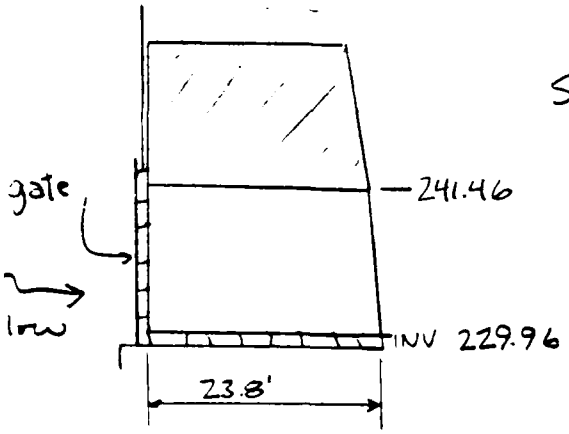


Longitudal Section

5 @ 107 sq ft each



Spillway X-sec



* sec thru outlet works

NTB / O NEEDLES TAMMEN & BERGENDOFF	Made by RY	Date 12/6/78	Job No 5628-11-13
	Checked by MWB	Date 5/15/79	Sheet No. 3

ewalls Falls

ep 1 Peak Inflow: Cal. Test Flood Inflow

Classification Size. Intermediate
Hazard: significant - Flood levels as calculated from the downstream damage evaluation would raise the maximum spillway discharge stage of 300 ft. by 1.6 feet.

In 1936 at Garvins Falls DA 2427 sqmi
Discharge = 122,000 cfs

Hydrologic Evaluation Guideline Recommends
1/2 PMF to PMF

Use 1/2PMF as size of reservoir on low end of Range
The 2233 sqmi. drainage area tributary to the Sewalls Falls Dam is outside the PMF guide curve envelope. Extrapolation of the curve to 2233 sqmi. will yeild unreliable results.

From: "Water Resources Investigation Merrimack River Basin" C.O.E. August 1972

lood equency	Discharge at Concord DA 2385 mi²	cfs / Sqmi	Discharge at Sewalls Falls DA. 2233 mi²
100yr *	142,000 cfs	59.5	133,000 cfs
200yr *	210,000 cfs	88.0	196,000 cfs
Project Flood	155,000 cfs	65.0	145,100 cfs
RAL Flood Project Flood fied by Existing Control Systems	92,800 cfs	38.9 cfs	86,900 cfs

without upstream flood control structures

TB NEEDLES TAMMEN & BERGENDOFF	Made by RY	Date 12/6/78	Job No. 5628-11-15
	Checked by PNP	Date 5/15/79	Sheet No. 4

Walls Falls

In flat costal areas the PMF is based on twice the standard project flood. (ref. "Preliminary Guidance for Estimating Maximum Probable Discharges")

Therefore use the standard project flood discharge modified by existing flood control systems

Test Flood Inflow = 86,900 cfs

ITB NEEDLES TAMMEN & BERGENDOFF	Made by RY	Date 12/18/78	Job No 5628-11-13
	Checked by [illegible]	Date 5/15/79	Sheet No 5

Sewalls Falls

D 2 Calculation of Surcharge by SDF

INFLOW = 86,900 cfs

Consider: 1. flow over spillway only
2. gates for power canal closed

Spillway weir hydraulics

$Q = CLH^{3/2}$ crest 240.9

where $C = 3.75$ Coefficient includes approach velocity as this is "run of river dam"

$L = 497$ ft.

$Q = 3.75(497)H^{3/2} = 1864H^{3/2}$

At Sewalls Falls 1936 flood est. discharge 115,000 cfs
Recorded H.W. elev 257.6
" TW elev 248.2

Tailwater will not significantly effect discharge over spillway at Q = 100,000 cfs or less.

Elev.	Head	Discharge
242.0	1.10 ft	2150 cfs
246.0	5.10	21,500
250.0	9.10	51,200
254.9	14.0	97,600
256.0	15.1	109,400
258.0	17.1	131,800
259.1	18.2	145,300

TB EDLES TAMMEN & BERGENDOFF	Made by RY	Date 12/6/78	Job No 5628-11-13
	Checked by [illegible]	Date 5/15/79	Sheet No 6

alls Falls

05 Effect of Surcharge Storage on Test Flood

PMFR = 9.5" as SDF = ½PMF

Reservoir surface area 350 acres

Q_{P_1} = 86,900 cfs

Surcharge$_1$ = 253.8 − 240.9 = 12.9 ft

$$\text{Stor}_1 = \frac{12.9 \text{ ft} \times 12 \text{ in/ft} \times 350 \text{ acres}}{2233 \text{ sq mi} \times 640 \text{ acres}} = 0.038 \text{ in}$$

$$Q_2 = Q_{P_1}\left(1 - \frac{\text{Stor}_1}{9.5}\right) = 86{,}900\left(1 - \frac{.038}{9.5}\right) = 86{,}550 \text{ cfs}$$

Surcharge$_2$ = 12.9 ft

$$\text{Stor}_2 = \frac{12.9 \times 12 \times 350}{2233 \times 640} = .038 \text{ in}$$

$$\text{STAVE}_1 = \frac{\text{Stor}_1 + \text{Stor}_2}{2} = .038 \text{ in}$$

to small storage available stor values will not
ange appreciably from values calculated
ie Q_{P_3} as outflow.

$$Q_2 = Q_{P_1}\left(1 - \frac{\text{STOR}_{AVE_1}}{9.5}\right) = 86{,}900\left(1 - \frac{.038}{9.5}\right) = 86{,}550 \text{ cfs}$$

Stage 12.9 ft elev. 253.8

DLES TAMMEN & BERGENDOFF	Made by RY	Date 12/6/78	Job No 5628-11-13
	Checked by PWP	Date 5/15/79	Sheet No 7

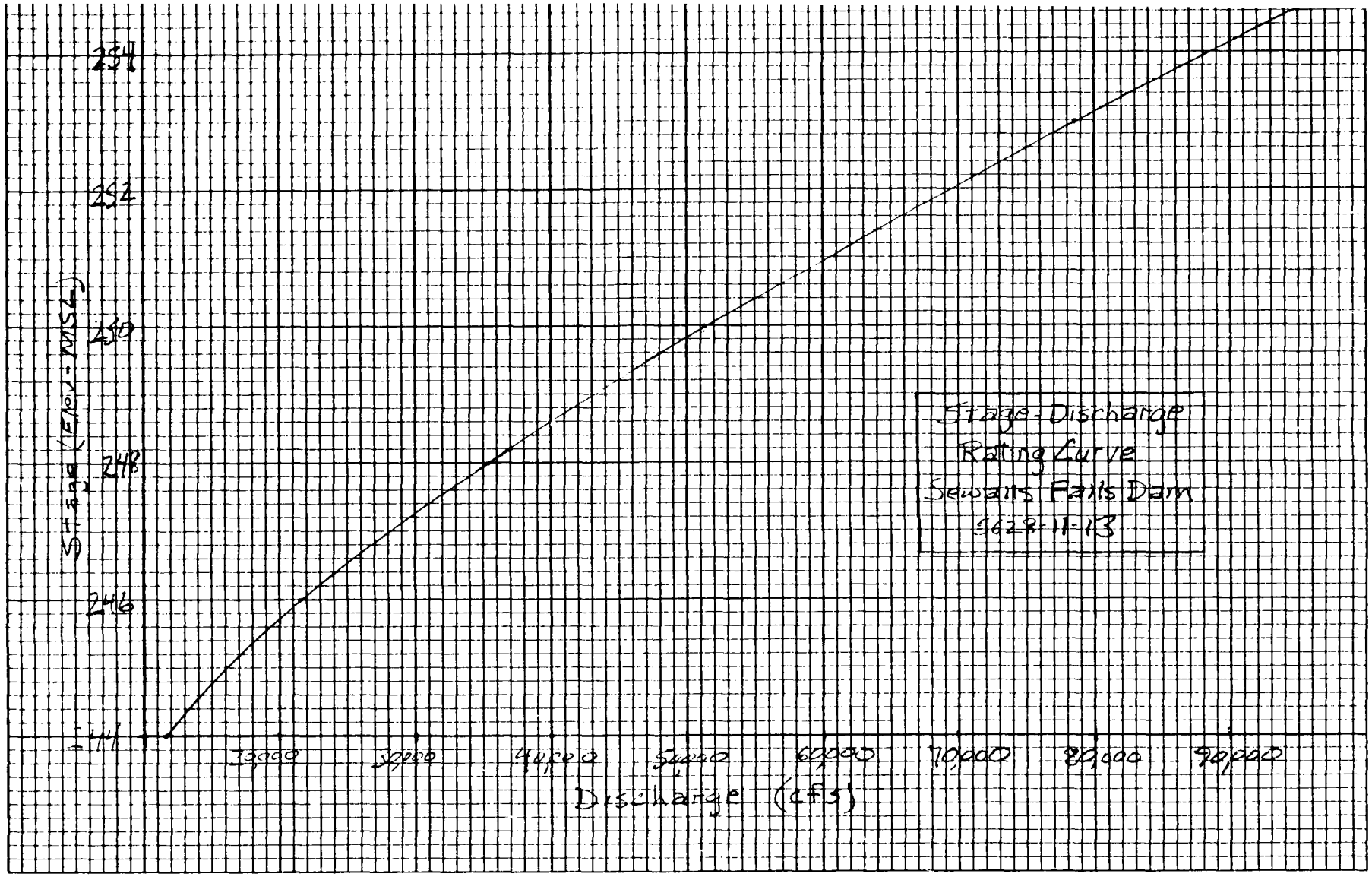
alls Falls

Conclusions

servoir storage will reduce the Test Flood at the tlet from 86,900 cfs to 86,550 cfs or by 0.4%

pillway and storage capacity can safely ass 100% of the Test Flood

the test discharge of 86,550 cfs the dam will ot be overtopped.


254
252
250
248
246
244
Stage (feet - MSL)
30,000
40,000
50,000
60,000
70,000
80,000
90,000
Discharge (cfs)
Stage-Discharge
Rating Curve
Sewalls Falls Dam
5628-11-13

S TAMMEN & BERGENDOFF	Made by RY	Date 11/20/78	Job No. 5628-11-13
	Checked by MNP	Date 5/15/79	Sheet No. 8

S FALLS

Estimate of Downstream Damage

Reservoir Capacity

Normal 3070 acre-ft @ 240.9 ft
Max unknown
Effective Max 1540 acre ft @ 259.1 feet see pg
see page 12 for calculation.

Peak Failure Outflow

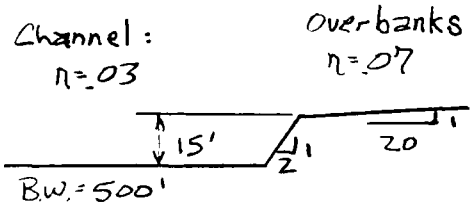
$Qp_1 = 8/27 \sqrt{g}\, W_b\, Y_b^{3/2}$

W_b = 40% of dam width = 40% (497)

Y_b = height from River bed to Max. pool
= 35.9 ft

$Qp_1 = 8/27 \sqrt{g}\,(.4)\,497\,(35.9)^{3/2} = 71{,}800$ cfs

3 Stage-Discharge Rating Curve

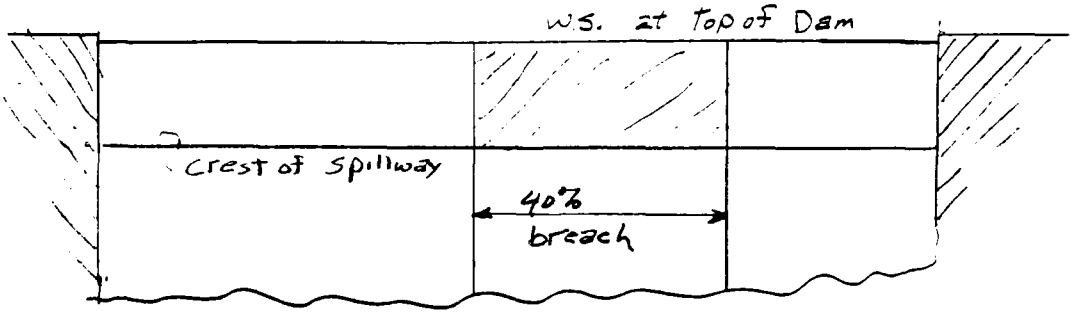


Reach Characteristics
S=.00033% (1936 flood profile)
n=.03 channel
.07 overbank
L=34000 ft

age - Discharge

~1,600 cfs
70,000
103,400
145,100
190,900

As this is a run of the river dam the full outflow at breach of dam will also include some of the spillway outflow



Outflow including spillway discharge

Q_T = 60% of full spillway + Breach outflow

$0.6 \times 145{,}300 + 71{,}800 = 159{,}000$ cfs

Downstream Stage @ 159,000 cfs = 31.6 ft

" @ 145,300 cfs = 30.8 ft

Step 4 Downstream Hydrograph S = 1540 acre-ft

Reach 1A 16,000 ft of 34,000 ft

$Q_{P_1} = 159{,}000$ cfs Stage 31.6 ft

$Q_S = 145{,}300$ $area_{P_1} = 22{,}700$ ft²

$\Delta Q = 13{,}700$ cfs $area_S = 20{,}800$ ft²

$\Delta area = 1{,}900$ ft²

$$V_1 = \frac{16{,}000(1900)}{43{,}560} = 698 \text{ acre ft} < 720 \text{ acre ft OK}$$

$$\Delta Q_{P_2} \text{ trial} = 13{,}700\left(1 - \frac{698}{1540}\right) = 7500 \text{ cfs}$$

$Q_{P_2} = 152{,}800$ cfs

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF	Made by RY	Date 6/15/79	Job No 5628-11-13
	Checked by [illegible]	Date 7/17/79	Sheet No. 10
For Seawalls			

$Q_{P_2T} = 152{,}800$ cfs Stage$_2$ 30.8 ft

$Q_S = 145{,}300$ Area$_{P_2}$ = 21,550 ft^2

20800

,750 ft^2

$$V_2 = \frac{16000 \times 750}{43560} = 275 \text{ acre-ft}$$

$V_{AVE} = 487$ acre-ft

$$\Delta Q_{P_2} = 13{,}700\left(1 - \frac{487}{1540}\right) = 9400 \text{ cfs}$$

$Q_{P_2} = 154{,}700$ cfs Stage 30.9 ft

Rock 13 18000 of 34000 ft $\Delta Q = 9400$ cfs $\Delta A = 1110$ ft^2

$$V_1 = \frac{18{,}000 \times 1110}{43560} = 459 \text{ acre ft} < \frac{1540}{2} \text{ OK}$$

$$\Delta Q_{P_{2T}} = 9400\left(1 - \frac{459}{1540}\right) = 6600 \text{ cfs}$$

$Q_{P_2} = 151{,}900$ cfs Stage 30.5 ft

Darea = 635 ft^2

$$V_2 = \frac{18000 \times 635}{43560} = 262 \text{ acre ft}$$

$V_{ave} = 361$ acre ft

$$\Delta Q_{P_2} = 9400\left(1 - \frac{361}{1540}\right) = 7200 \text{ cfs}$$

$Q_{P_2} = 152{,}500$ cfs Stage = 30.6 ft

HNTB HOWARD NEEDLES TAMMEN & BERGENDOFF	Made by	Date 6/15/79	Job No. 5628-11-13
	Checked by	Date 7/17/79	Sheet No. 11
For Sewalls			

Note: 2/3 Rule for downstream breach wave not applicable due to high river stage prior to breach of dam

Location	Stage	Rise
At Dam	31.6 ft	1.6 ft
16,000 feet downstream	30.9	0.9 ft
34000 feet downstream at B&M R.R. bridge	30.6	0.6 ft

Downstream Stage Prior to Breach 30.0

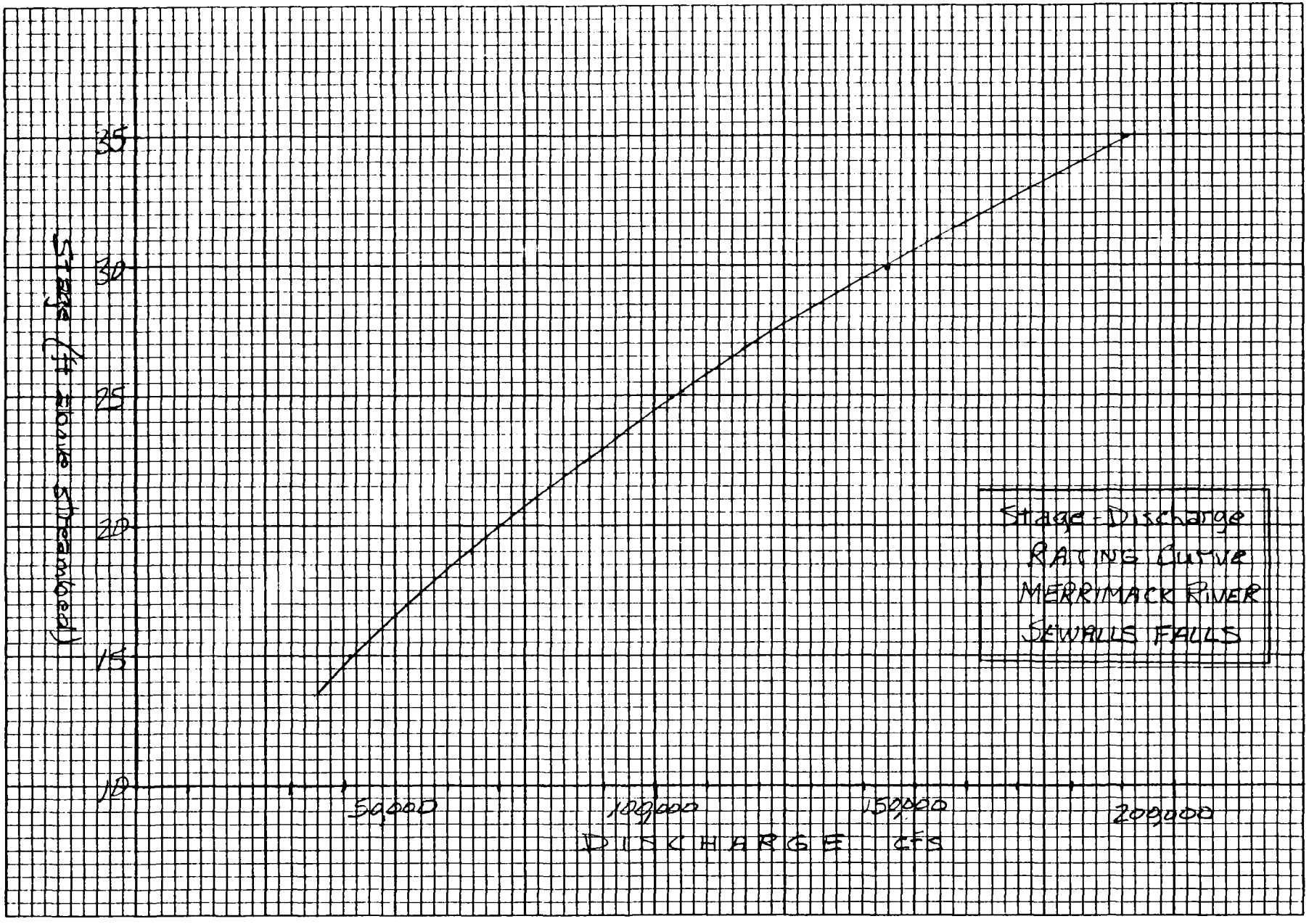

35
30
25
20
15
10
STAGE (ft above streambed)
50,000
100,000
150,000
200,000
DISCHARGE cfs
Stage-Discharge
RATING CURVE
MERRIMACK RIVER
SEWALLS FALLS

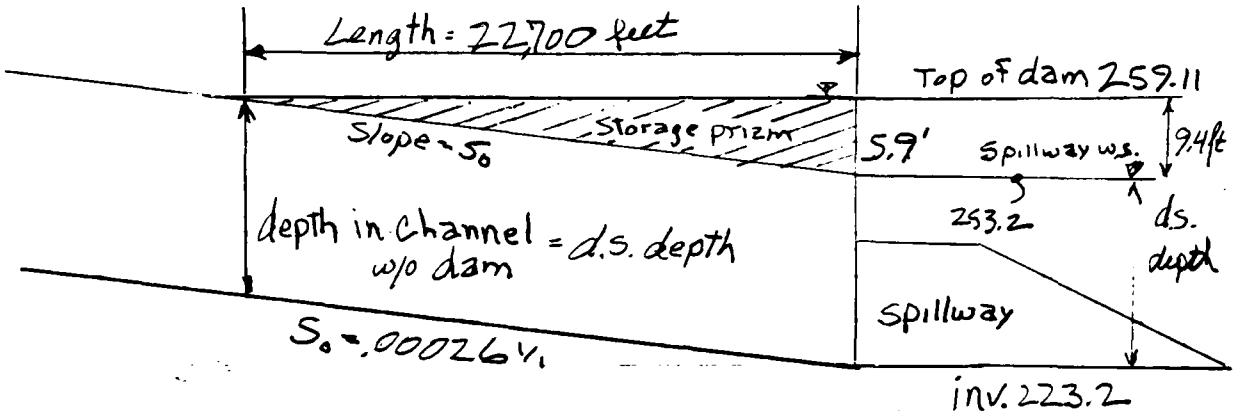
FIGURE 2

HNTB
HOWARD NEEDLES TAMMEN & BERGENDOFF

Made by RY	Date 6/15/79	Job No 5628-11-13
Checked by MNM	Date 7/17/79	Sheet No 12

For Sewalls

Reservoir Capacity
Storage for D.D. cales



Spillway Flow with water surface at top of dam

145,300 cfs Stage 30.0 ft d.s. of dam = w.s. of 253.2

Top of dam = 259.1
Downstream w.s. 253.2
height of storage prizm = 5.9 ft

Length of pool $5.9 \text{ ft} / .00026\tfrac{1}{2} = 22{,}700 \text{ ft}$

Assume ave flood plain width of 1000 ft in upstream areas

Storage volume = $\left(\frac{5.9 \times 22700}{2}\right) 1000$

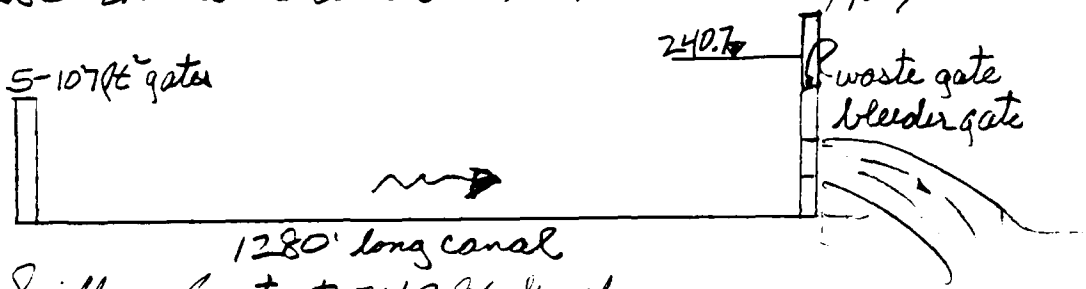
= 1537 acre-ft

HNTB EDWARD NEEDLES TAMMEN & BERGENDOFF	Made by RY	Date 6/15/79	Job No. 5628-11-13
	Checked by [illegible]	Date 7/17/79	Sheet No. 13

Sewalls

Outlet Works – Discharge Capacity at top of Spillway

5-107 sq ft gates inv. 229.96
10'x8.5' waste gate inv. 235.86
6.5'x4.67' bleeder gate inv 225.86
1280' diversion canal 10'x100' x-sec approximate



Spillway Crest at 240.86 ft elev.
Assume w.s. at d.s. end of canal 240.7 ft

Bleeder gate $Q = CA\sqrt{2gh}$ $A = 30.36\ ft^2$
$C = .7$
$H = 10.17\ ft$

$Q = .7(30.36)\sqrt{64.4(10.17)} = 544$ cfs

Waste Gate 10' wide $H = 4.84$, 240.70 − 235.86

assume dc thru openning

$Q = \left(\frac{4.84}{1.5}\right)^{1.5}(10)\sqrt{g} = dc^{1.5}(10)\sqrt{g} = 329$ cfs

Total thru gates at elev 2407 = 873 cfs

Losses thru canal
$A = 1000$ sq ft $R = 8.33'$

$$H_f = S_f \times L = \left(\frac{Qn}{R^{2/3} A\, 1.49}\right)^2 \times 1280 = \left(\frac{873(.03)}{8.33^{2/3}(1000)1.49}\right)^2 \times 1280$$

$H_f = 1.83\times10^{-5}\times1280 = .02$ ft

water surface at head of canal 240.7
+ .02
240.72

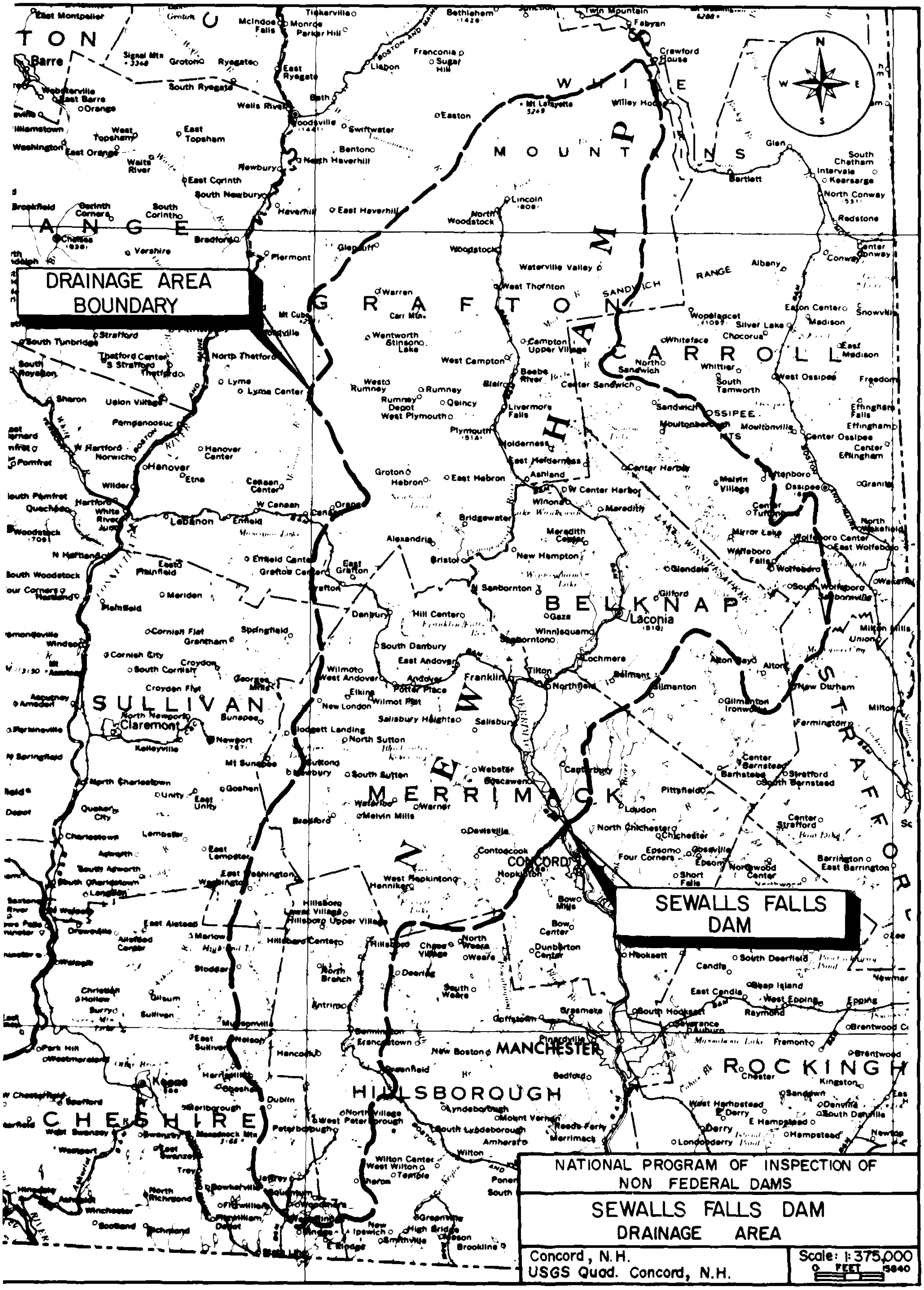
H req'd thru 5-107 ft² gates

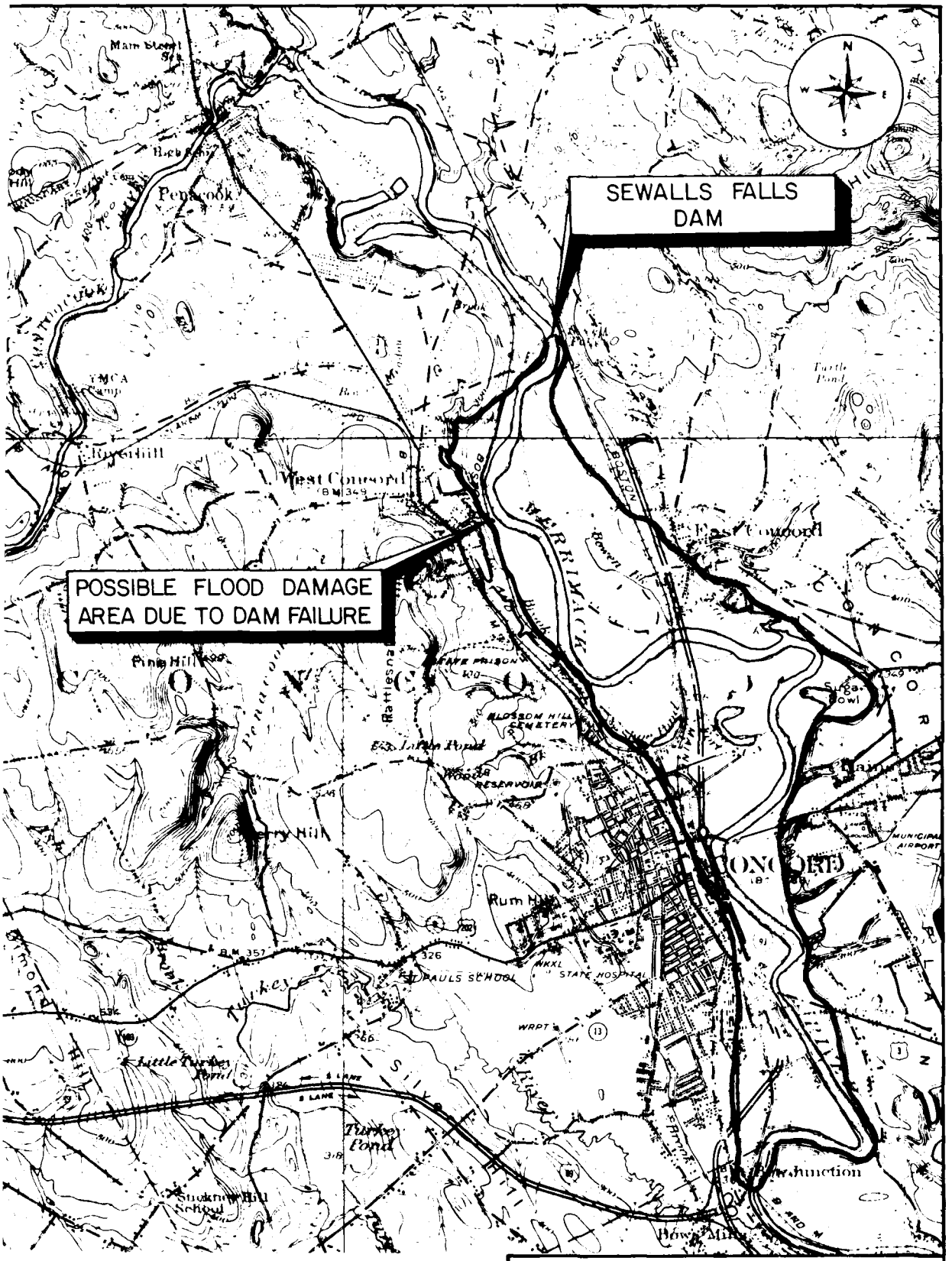
$Q = CA\sqrt{2gh}$ $Q = 873$ cfs ✓

$h = \left(\frac{Q}{CA}\right)^2 \frac{1}{2g} = \left(\frac{873}{.6(5)(107)}\right)^2 \frac{1}{64.4} = .11$ ft ✓

head upstream of gates 240.72'
+ .11'
240.83 ~ 240.86'

Capacity of outlet works about 880 cfs.


DRAINAGE AREA BOUNDARY
SEWALLS FALLS DAM
NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS
SEWALLS FALLS DAM
DRAINAGE AREA
Concord, N.H.
USGS Quad. Concord, N.H.
Scale: 1:375,000
GRAFTON
CARROLL
BELKNAP
MERRIMACK
SULLIVAN
HILLSBOROUGH
CHESHIRE
ROCKINGH
STRAFFORD
NEW HAMPSHIRE
WHITE MOUNTAINS
CONCORD
MANCHESTER
Laconia
Franklin
Claremont
Keene



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

SEWALLS FALLS DAM
POSSIBLE FLOOD DAMAGE AREA

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

END

FILMED

7-85

DTIC